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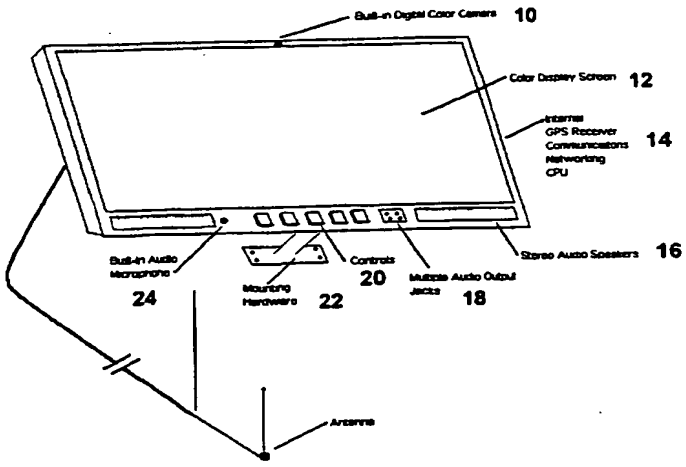

(57) Abstract: A network permits communications between and among moving vehicles, such as automobiles, and fixed stations, such as transceivers. The fixed transceivers could be located, for example, on a specially equipped road system or global positioning satellites (GPS). A communications unit on each vehicle is capable of transmitting information and receiving information transmitted from other moving or stationary units (e.g., on the specially equipped road system). A preferred embodiment of the communications unit transmits data indicative of its current location, so that each communications unit "knows" the physical location of the other communications units. The communications units use wireless transmission and reception to communicate with each other. Dynamic IP addressing is provided such that each communications device is associated with a local network having a local pool of dynamic IP addresses, such that the local pool of dynamic IP addresses is associated with a predefined geographic area or volume in.

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METHOD AND SYSTEM FOR DATA COMMUNICATIONS AND DYNAMIC NETWORKING BETWEEN VEHICLES

CROSS REFERENCE TO RELATED APPLICATIONS

This application is entitled to the benefit of the priority date of U.S. Provisional Application Serial No. 60/141,658, filed June 30, 1999, the disclosure of which is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

The present invention relates generally to data communications, and more particularly to data communication and dynamic networking between vehicles. As discussed below, the invention may be used in a variety of applications, including news and entertainment broadcasting; direction finding, Internet access; location finding; voice, video and data communications; vehicle tracking, and the like.

Background information concerning networking, including dynamic networking, can be found in the following United States patents:

6,052,725	4/18/2000	McCann et al.
5,835,723	11/10/1998	Andrews et al.
5,812,819	9/22/1998	Rodwin et al
5,557,748	9/17/1996	Norris
5,150,464	9/22/1992	Sidhu et al.

SUMMARY OF THE INVENTION

A presently preferred implementation of the invention provides a network to permit communications between and among moving vehicles, such as automobiles, and fixed stations, such as transceivers. The fixed transceivers could be located, for example, on a specially equipped road system or global positioning satellites (GPS). A communications unit on each vehicle is capable of transmitting information and receiving information transmitted from other moving or stationary units (e.g., on the specially equipped road system). A preferred embodiment of the communications unit transmits data indicative of its current location, so that each communications unit "knows" the physical location of the other communications units.

The communications units preferably employ wireless transmission and reception to communicate with each other. Dynamic IP addressing may be provided such that each

communications device is associated with a local network having a local pool of dynamic IP addresses, such that the local pool of dynamic IP addresses is associated with a predefined geographic area or volume in space. Each communications unit is thus uniquely identifiable by an identification number, and each is capable of working together with other units in a coordinated process of transmitting and receiving information. The communications unit has a limited wireless transmission range for sending wireless information to another unit. When a transmission is received by a first unit from another unit entering the physical operating range of the first unit, the two (or more) units establish a coordinated information dialog, such as in a data information network, until one of the units leaves the physical operating range or is deactivated or leaves the logical operating range. If another communications unit enters the operating range of an existing dialog between two units, then the existing dialog (network) is expanded and the additional unit is brought into the dialog (network). Many such networks can be simultaneously established between different sets of communications units based upon their relative separations and operational ranges. The communications networks are dynamically established and dissolved as the communications units move in and out of each other's logical or physical operating range.

Other aspects of the present invention are described below.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 depicts one embodiment of a communications unit in accordance with the present invention.

Figure 2 depicts an exemplary subnet or workgroup relationship in accordance with the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS AND BEST MODE

Figure 1 depicts an exemplary embodiment of a communications unit display station. The unit includes a built-in color camera 10, color display screen 12, internal GPS receiver and CPU 14, stereo audio speakers 16, audio output jacks 18, user input controls 20, mounting hardware 22, microphone 24, and antenna 26. This device is relatively straightforward to construct, and so we will not describe the hardware of the communications unit in greater detail.

The connectivity between communications units can be coordinated using a concept of dynamic subnets or dynamic workgroups, which can be devised upon geographic vicinity or other means. If devised by geographic vicinity, a contiguous arrangement of geographic areas (i.e., a "geo-area") would be established, each with an identification number (i.e., a "geo-id"). A communications unit would determine its current position using a known method such as GPS, and then determine its current geo-id based upon, e.g., a predetermined lookup table or mathematical formula. The geo-id could then be used to determine the unit's current subnet or workgroup setting. Such subnet or workgroup setting may then be used by the communications unit to establish itself as a node in a larger network of communications units. The subnet or workgroup setting can also be used in the communications network design to coordinate the dynamic movement of communications units between subnets or workgroups. A diagram depicting an example of possible geo-ids and subnet or workgroup relationships is shown in **Figure 2.**

An adjustable range feature allows the communications units to receive and process or reject transmitted information based upon criteria contained inside each information transmission. Such information may contain criteria be based upon physical geography, such as latitude, longitude and radius of applicability, or it may be based upon logical information, such as group identification (e.g., "all vehicles belonging to our truck fleet"), or combination of criteria ("all vehicles belonging to our truck fleet currently traveling on I-95 between Phila and NYC") for applicability.

One aspect of the present invention concerns a method of providing dynamic Internet Protocol (IP) addressing in a communications system. A communications device that accesses data from an IP network is associated with a local network having a local pool of dynamic IP addresses. This local pool of IP addresses is associated with a predefined geographic area or volume in space. The inventive method comprises the following acts: determination by a communications device of its current geographic position and a defined geographical boundary; selection of a dynamic IP address from a predetermined pool of IP addresses assigned to the current geographic position's defined geographical boundary; and determining if such dynamic IP address is currently assigned to another communication device within the current geographic boundary.

Another aspect of the present invention relates to a method of providing dynamic IP addressing such that the respective communications devices are associated with a local network having a local pool of dynamic IP addresses, such that the local pool of dynamic IP addresses is associated with a predefined geographic area or volume in space. The method includes, determination of the current geographic position of the communications device; assignment of unused dynamic IP address to the communications device; and communicating the assigned IP address to the communications device.

Yet another aspect of the present invention concerns an addressable group of communications devices created by identifying a contiguous arrangement of distinct geographic areas or volumes, each with a unique identifier, and each with an preassigned pool of IP addresses, which addresses can be dynamically assigned to one or more communications devices inside one of the said geographic areas, resulting in a group of communications devices whose addresses are a subset of the known pool of addresses, thus creating the addressable group of communications devices.

The invention also provides a method of providing reassignment of a new dynamic IP address to a communications device without disruption of an existing communications session with a remote host via an old IP address. This method includes determining the new IP address while maintaining the existing IP address and communications session; establishing a new communications channel on the communications device, which uses the new IP address; issuing a notification of the new IP address to the remote host, which, upon receipt of such notification, redirects the communications session to the new IP address; and resumption by the communications device of communications with the remote session using the new IP address.

The invention further provides a method of establishing data routing between two groups of communications devices. Each group is located in an adjoining geographic area or spatial volume. A communications device maintains two IP addresses, one address belonging to the subset of possible IP addresses preassigned to the first group, and the other address belonging to the set of possible IP addresses preassigned to the second group. The communications device determines the new IP address while maintaining the existing IP address and communication session; establishes a new communications channel on the communications device, which uses the new IP address;

and issues a notification to members of the group whose possible addresses include the first IP address, and to the group whose possible addresses include the second IP address, that the communications device has established itself as a data router between the two groups.

The following sections outline exemplary applications of the present invention.

Collision Avoidance and Warning System

A collision avoidance and warning system may use the communications network to coordinate relative position of vehicles surrounding each communications unit, or impending states or condition of said vehicles surrounding each communications unit, such as emergency braking and deceleration of a vehicle or vehicles in the distant path of travel of the said communications unit. A practical application of such collision avoidance and warning system would be as a safety device installed in all newly manufactured cars, trucks, SUVs, motorcycles, and other road vehicles.

News Broadcasting System

A news broadcasting system may use the communications network to transmit information from a central broadcasting point, and such information may be communicated from one communications unit to others in a radial propagation from the broadcast system. A news discrimination capability that allows each communications unit to distinguish information based upon the communications unit's current geographic position and an optional target geography specified in each news broadcast item. A practical application of this news broadcasting system would be to disseminate travel advisories or road condition information. Since the invention has the ability to discern by logical or physical geographic applicability, such travel advisories or road condition information can be very specific to a particular road or stretch of road, and the receiving communications unit can filter in only those broadcasts of interest by specifying filter parameters, such as "Traffic Advisories: I-95 Southbound between Exit 16 and the Phila International Airport". Such parameter selection can be made easy to use and choose by implementing a user interface such as graphical touch screen, voice activated controls, or memorized settings.

Direction System

A mobile direction system may use the communications network, permitting requests for directions from a current position to a desired destination. The current

position of a communications unit and desired destination could be transmitted to a central direction system that determines and transmits directions to the communications unit, which would display written and graphical directions on its screen. This represents an improvement over current direction-giving devices that use a static stored database (such as on a CD-ROM), because such a central system can contain up-to-date directions and maps for all areas, without the need to obtain, change, or update CD-ROMs.

Internet Access

A mobile Internet access system can use the communications network to transmit TCP/IP data from a central Internet gateway, through the communications network, to the communications unit. Web browsing, email access, and all other services provided though the Internet are made available through the communications unit.

Entertainment Broadcasting and Receiving

An entertainment broadcasting and receiving system can use the communications network to transmit music or movies in digital form from a central broadcasting point, and such information can be communicated from a communications unit to others in a radial propagation from the broadcast system. A selection capability can be provided to permit choice of desired music track or movie from the communications unit. In the case of music, such transmitted music is received by the communications unit and then output to optional audio output speakers or headphone jack that can be part of the communications unit, or into an existing vehicle radio system by using wire connections or a special short-range FM broadcast frequency. In the case of transmitted movies, such digital movies may be received by the communications unit and displayed on the color display. The audio portion of the movie can be output to speakers, headphone jack, or car radio as described above for music transmissions. Such music or movies can be selected and activated from the communications units, such as in a "pay-per-view" scenario or music jukebox scenario. A practical application of the entertainment broadcasting and receiving system would be as an enhancement to the in-vehicle video/audio playback entertainment center accessory currently offered in some vehicles.

Position Communication and Display

A dynamic position communication and display system can employ the communications network. In this case, each communications unit transmits its current geographic position to other communications units, and each unit receives position

information of other communications units. A dynamic graphical display system displays each communications unit and its geographic position relative to the receiving communications unit, similar to a radar system display. A practical example of application of such a position communication and display system would be to instantly determine current traffic jam situations along one's planned route. Since the system uses real-time data, it can report traffic jams more accurately than current methods, such as news reporters on the telephone. Since the system can access data originating from any specified geographic location, traffic jams can be detected from any point along a road, not only at a few selected monitoring points such as current road-side Internet cameras.

Inter-Vehicle Voice, Video and Data Communications

An illustrative inter-vehicle voice, video, and data communications system allows bi-directional transmission of voice, video or data between two or more communications units by encoding such voice or data into digital format and transmitting it along the communications network. An instant voice communication feature with which the caller can touch the graphical representation of the intended receiver on the graphical display system, and a voice, video, or data communications session is established between the current and target communications units. Such voice communication feature could be extended beyond the current physical range of the vehicle's communications unit by utilizing retransmission of data from vehicle to vehicle, or from vehicle to stationary communications units installed at central locations. As a practical example, such voice and data communication system could be as a replacement for cellular telephones, pagers, videophone, and personal data assistants (PDAs).

Tracking and Data Logging

Electronic vehicle tracking and data logging can be provided by using the communications network, which would perform continuous acquisition of the vehicle's driving profile, such as date, time, location, speed and recording of such data to a storage device located in the vehicle or a remote storage device. For example, such a profiling system could be installed in commercial fleet vehicles, such as delivery trucks, and the current and past location of any vehicle so equipped could be examined by the dispatcher. In another possible application, such a profiling system could be used as a theft deterrent system and stolen vehicle police recovery system. In another possible application, such a profiling system could be used by the automobile insurance industry

as a voluntary means of safe driver certification, and thereby extending insurance premium discounts to such voluntarily certified drivers. In this application, the vehicle profiling system could be used to record date, time, location, speed, and relative location of other so equipped vehicles. Using this data, one could determine such parameters as vehicle acceleration, driving distance relative to another so equipped vehicle (i.e., to ascertain tailgating or safe following distances), and even traffic violation situations (i.e., speed beyond posted speed limits, running or jumping red lights at intersections equipped with such device, etc.). In another practical application, recorded data or video information could be used as supporting legal evidence in traffic accident or public transportation litigation or accident reconstruction efforts. In another practical application, such profiling could be used by government transportation engineers to ascertain the traffic patters and driving profiles over large areas of road systems. For example, traffic engineers could instantly access the count of vehicle at any point on the roadway without installing the mechanical vehicle counting devices typically used today. Additional information such as speed, acceleration, and travel paths could assist traffic engineers to further improve the roadways.

The invention described above is not limited to the presently preferred, exemplary embodiments and applications disclosed. Those skilled in the art will recognize that the invention may be adopted for use in various current and future applications, and in various hardware and software forms, without departure from the teachings set forth herein.

What is claimed is:

1. A method of providing dynamic Internet Protocol (IP) addressing in a communications system having a communications device for accessing data from an IP network such that the communications device is associated with a local network having a local pool of dynamic IP addresses, such that the local pool of dynamic IP addresses is associated with a predefined geographic area or volume in space, comprising:

determination by a communications device of its current geographic position and a defined geographical boundary;

selection of a dynamic IP address from a predetermined pool of IP addresses assigned to the current geographic position's defined geographical boundary; and

determining if such dynamic IP address is currently assigned to another communication device within the current geographic boundary.

2. A method of providing dynamic Internet Protocol (IP) addressing in a communications system having a communications device for accessing data from an IP network such that the communications device is associated with a local network having a local pool of dynamic IP addresses, such that the local pool of dynamic IP addresses is associated with a predefined geographic area or volume in space, comprising:

determination of the current geographic position of the communications device; and

assignment of unused dynamic IP address to the communications device; and

communicating the assigned IP address to the communications device.

3. An addressable group of communications devices created by identifying a contiguous arrangement of distinct geographic areas or volumes, each with a unique identifier, and each with an preassigned pool of IP addresses, which addresses can be dynamically assigned to one or more communications devices inside one of the said geographic areas, resulting in a group of communications devices whose addresses are a subset of the known pool of addresses, thus creating the addressable group of communications devices.

4. A method of providing reassignment of a new dynamic IP address to a communications device without disruption of an existing communications session with a remote host via an old IP address, comprising:

determining the new IP address while maintaining the existing IP address and communications session;

establishing a new communications channel on the communications device, which uses the new IP address;

issuing a notification of the new IP address to the remote host, which, upon receipt of such notification, redirects the communications session to the new IP address; and

resumption by the communications device of communications with the remote session using the new IP address.

5. A method of establishing data routing between two groups of communications devices, each group located in an adjoining geographic area or spatial volume, by a communications device which maintains two IP addresses, in which one address belongs to the subset of possible IP addresses preassigned to the first group, and the second address belongs to the set of possible IP addresses preassigned to the second group, where such communications device:

determines the new IP address while maintaining the existing IP address and communication session;

establishes a new communications channel on the communications device, which uses the new IP address; and

issues a notification to members of the group whose possible addresses include the first IP address, and to the group whose possible addresses include the second IP address, that said communications device has established itself as a data router between the two groups.

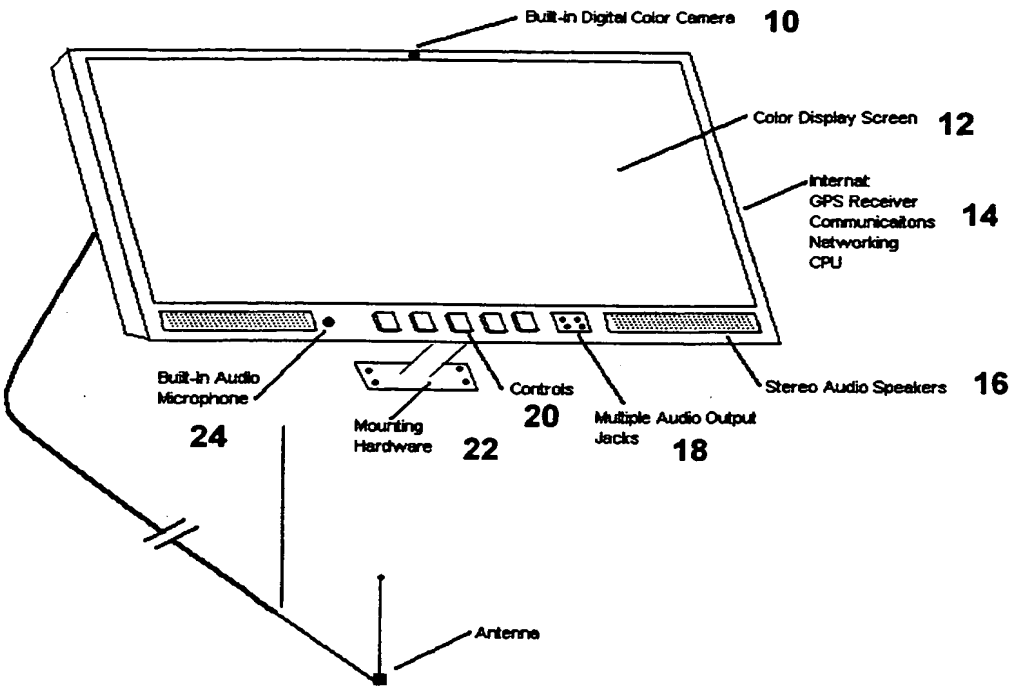

Figure 1

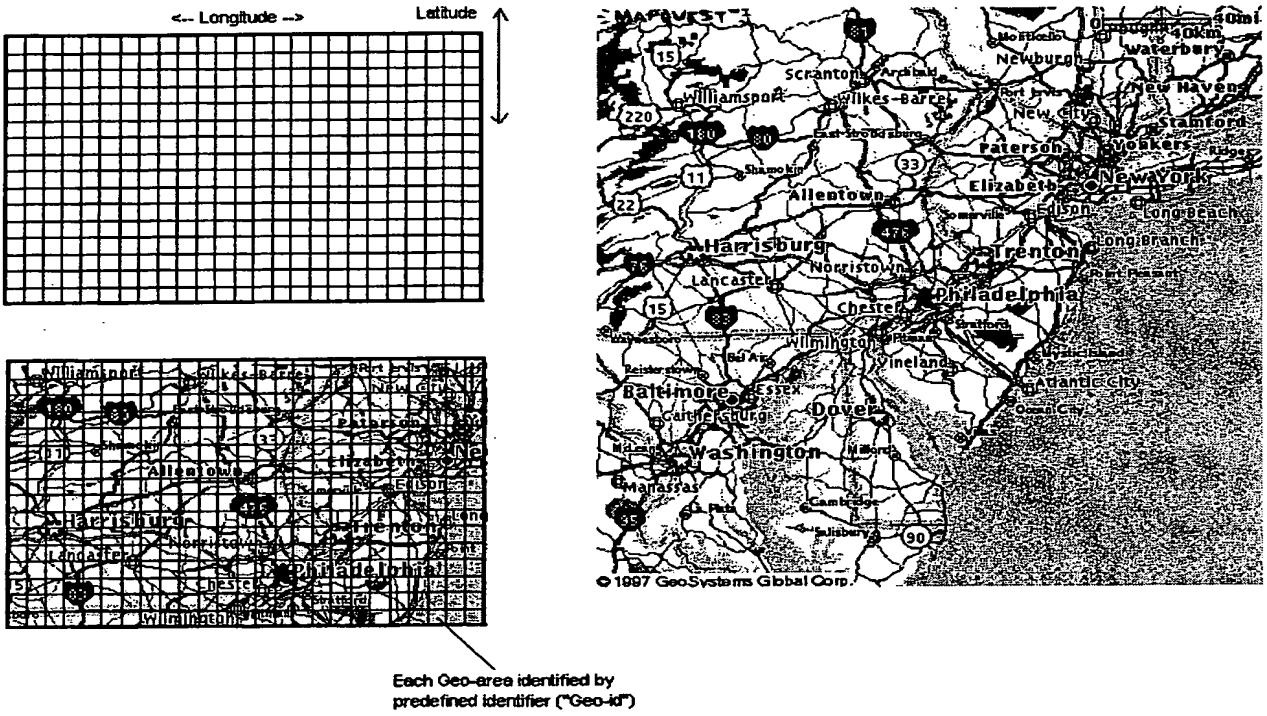

Figure 2 (Continuous Arrangement of Geo-Areas)